Are plant communities water-stressed?

Seasonal and pluri-annual dynamics of vegetation water stress along a soil depth gradient in a Mediterranean rangeland

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Introduction

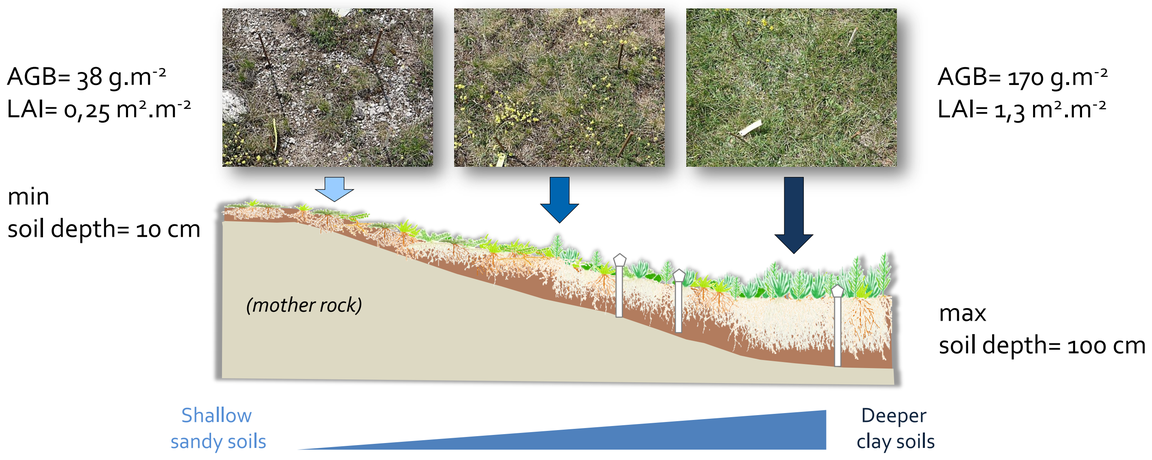
Predicting the dynamics and impacts of vegetation water stress under increasing droughts is a key issue for water-limited ecosystems. However, assessing water stress at the ecosystem level is not straightforward since several plant species with different water use strategies usually co-exist, especially in heterogeneous environments. This study aimed to evaluate whether plant communities under the same climate but with contrasting edaphic conditions respond differently to temporal fluctuations in soil water availability in a Mediterranean rangeland of Southern France (Larzac Causse) . We addressed the following question:

Does soil water storage capacity influence seasonal and pluri-annual water stress?

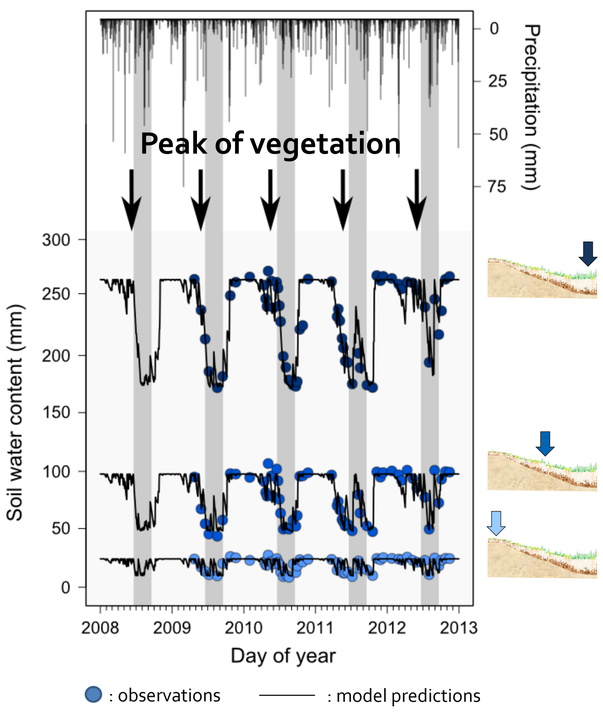
Seasonal water stress has similar dynamics and magnitude along the soil depth gradient

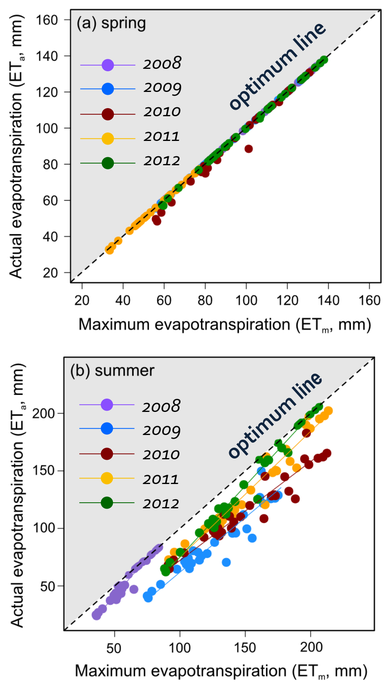
Materials & Methods

- Sampling of 36 plant communities along a soil depth gradient
- 5-years monitoring of soil water (*Diviner 2000* moisture probes)
- Modeling soil water dynamics (using a bucket-type water balance model)



A gradient in soil water storage capacity





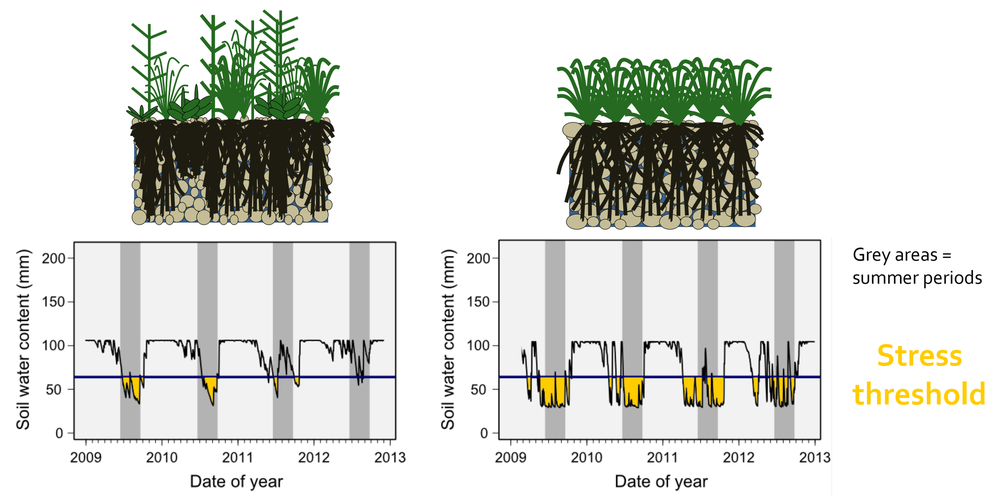
- **Same seasonal dynamics of soil water**
- **Proportional soil water depletion**

(a) spring:
no stress (ET_a=ET_m)
(b) summer:
Similar stress (ET_a<ET_m)

Pluri-annual water stress is buffered and remains low along the soil depth gradient

Materials & Methods

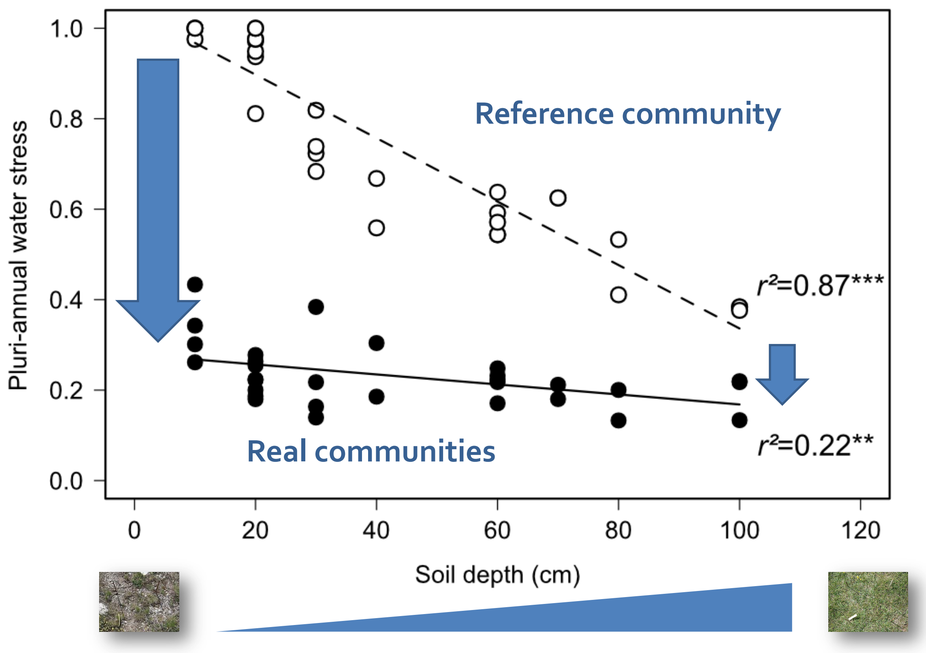
- Simulating soil water dynamics for a virtual 'reference' plant community
- Determining the pluri-annual integrated water stress over 5 years
- Comparing real vs. reference communities along the soil depth gradient



***Water stress** reflects:*
- *abiotic conditions*
- *vegetation adapatation*

***Water stress** reflects:*
- *abiotic conditions only*

(= 'control' plant community)



Although deacreasing soil water storage capacity creates stressful conditions (see reference community), pluri-annual water stress in real plant communities remains more or less constant

Conclusion

Our results suggest that water-use rates of vegetation have been 'adjusted' to the local soil water storage capacity, resulting in similar soil water dynamics and vegetation water stress along the soil depth gradient. Increasing summer droughts in the Mediterranean may therefore have a similar impact on all plant communities of such rangeland ecosystems. It would be relevant to identify the thresholds of intensity, duration and frequency of drought that trigger permanent shifts in species composition and dominance patterns, in relation with the long term resilience of plant communities.